

Customer No.: 31561

Application No.: 10/064,882

Docket NO.: 7857-US-PA

REMARKS***Present Status of the Application***

Claims 12-15 remain pending of which Claim 12 has been amended to more clearly describe the present invention. Further, specification has been amended in order to correct some typographic errors. It is believed that no new matter adds by way of these amendments to specification or otherwise to the application. For at least the following reasons, Applicants respectfully submit that claims 12-15 are in proper condition for allowance. Reconsideration is respectfully requested.

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Response to Objections to Drawing under 37 CFR 1.84

1. The Office Action objected to the drawings for failing to comply with 37 CFR 1.84 because they do not include the reference character 112" mentioned in the description.

In response thereto, Applicants have amended paragraphs [0026] and [0027] of the specification. After entry of the amendments to specification, it is believed that the above objections can be overcome. Reconsideration is respectfully requested.

Response to Rejections under 35 U. S. C. 103

2. The Office Action rejected claims 12-15 under 35 U.S.C. 103(a) as being unpatentable over Nishi et al. (US-5,760,454, hereinafter Nishi) in view of Takiyama et al. (US-5,559,351, hereinafter Takiyama).

In rejecting the above claims, the Office Action stated that Nishi discloses a NROM memory cell structure which is similar to claimed invention except that (on page 3 of the office Action), Nishi however fails to specify the material of the gate oxide. However, Takiyama on the other hand, teaches that Nishi's gate oxide may be an oxide-nitride-oxide (O-N-O) layer. It would have been obvious at the time of the invention to one skilled in the art to have an oxide-nitride-oxide layer as Nishi's gate oxide, as taught by Takiyama, since ONO layers are commonly known in the semiconductor art for their use as gate oxides.

Applicants respectfully disagree and would like to point out that the question is not simply whether the prior art teaches the particular element of the invention, but whether it would suggest the desirability, and thus the obviousness, of making the

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combination. Neither the Nishi patent nor the Takiyama patent disclose, teach or hint the problems associated with the operation of the flash memory cell in a radio active environment. Instead, Nishi discloses gate structure of a MOS transistor that could allow further miniaturization thereof and increasing the operation speed thereof. Whereas, Takiyama merely suggest (col. 13, lines 40-42) that their invention, i. e. the inclusion of chromium only in the region of the silicon oxide film, the region including the interface between the silicon film and the top electrode and the vicinity of the interface, capable of controlling the threshold voltage without reducing the dielectric breakdown voltage of the silicon oxide, may also be applied to a field transistor provided with ONO film, and not more.

As it is well recognized in the art that the gate oxide of a MOS is for conducting the current, and whereas the ONO of an NROM composite layer is for storing electrons. Therefore the functionality of the gate oxide of MOS of Nishi and the ONO (or the gate oxide) Takiyama are totally different. Accordingly, the showing of Nishi and Takiyama cannot possibly lead one skilled in the art to possibly modify the gate oxide layer of Nishi MOS structure with an ONO composite layer, in a manner suggested by the Office Action to achieve every features of the claimed invention.

Further, Applicants would like to point out that the question here is whether the prior art recognized the cause of the problem. As discussed above, it is clearly evident that both Nishi and Takiyama failed to recognize the problems associated with the operation of a flash memory in a radio active environment, and therefore Nishi and Takiyama cannot possibly teach, suggest or hint one skilled in the art any solutions for resolving the problems associated with the operation of the flash memory cell in a radio

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~~active environment, much less teaching on the use of both hexagonal shaped gate~~
structure together with an ONO gate oxide layer could resolve the problems associated with the operation of a flash memory cell in a radio active environment.

The present inventors were faced with problems that when a flash memory operates in a radio active environment that photons having energy in excess of 4.3 eV may be transferred to electrons so that electrons jump the energy barrier and radiate. If the electron is located in an oxide layer, the electron may be rapidly transferred to a substrate or a control gate due to the effect of an electric field. In general electrons lost in this manner may lead to lowering of threshold voltage of the flash memory. To resolve this problems, the present inventors proposed to design the gate of the NROM flash memory cell into a hexagonal shape and a gate oxide layer comprised of ONO layer so that when the flash memory is subjected to radiation illumination, electron hole pairs thus generated will be injected into the substrate instead of nitride layer without passing into the nitride layer. Because the electron holes produced by the radiation bypass the nitride layer, therefore the trapped electrons inside the nitride layer 120b will not be neutralized. Thus, the threshold voltage of the flash memory will remain at a constant value. Accordingly, a hexagonal gate structure together with the ONO gate oxide layer can effectively prevent second bit effect and source-side injection and also is capable of improving the data retention.

In other words, the problems confronted by the inventor must be considered in determining whether it would have been obvious to combine references in order to solve that problem. Because both Nishi and Takiyama substantially fails to even mention the problems associated with the operation of the flash memory cell in a radio active

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~~environment much less teaching on the advantages of the shape of the gate structure~~

with an ONO gate oxide for a memory cell for overcoming the problems due to illumination by radiation. Accordingly, Applicants respectfully submit that teachings of Nishi and Takiyama cannot possibly lead one skilled in the art to take the advantage of combination of an hexagonal gate and the ONO gate oxide to resolve the problems associated with the operation of the flash memory cell in a radio active environment. Accordingly, Applicants respectfully submit that the prior arts of record cannot possibly render every features of claim 12 obvious in this regard.

For at least the foregoing reasons, claims 12-15 patently define over prior art of record. Reconsideration and withdrawal of these rejections is respectfully requested.

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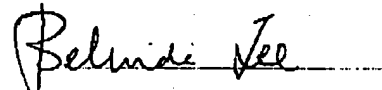
CONCLUSION

For at least the foregoing reasons, it is believed that all pending claims 12-15 are in proper condition for allowance. If the Examiner believes that a conference would be of value in expediting the prosecution of this application, he is cordially invited to telephone the undersigned counsel to arrange for such a conference.

Respectfully submitted

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